CHAPTER 3

PAVEMENT MANAGEMENT AND EVALUATION

300.00 PAVEMENT MANAGEMENT

Pavement Management annually surveys each mile of the State Highway System for ride roughness and pavement cracking. In addition, rut depth measurements are taken annually on all interstate highways. Skid resistance measurements are taken on a priority basis, with special requests given top priority, whereas routine inventory tests are conducted as time permits. Airports under the State Airport System are also annually surveyed for ride and cracking as time permits. The reports detailing the results of these tests are made available to pavement designers in order to improve overlay and rehabilitation designs. In addition, the survey data is used in the development of the Five Year Construction Program. Each Preservation Project in the 5-year program is tested for deflection and the results of these tests are used to help determine overlay thickness and type of material.

300.01 PAVEMENT MANAGEMENT GOALS AND OBJECTIVES

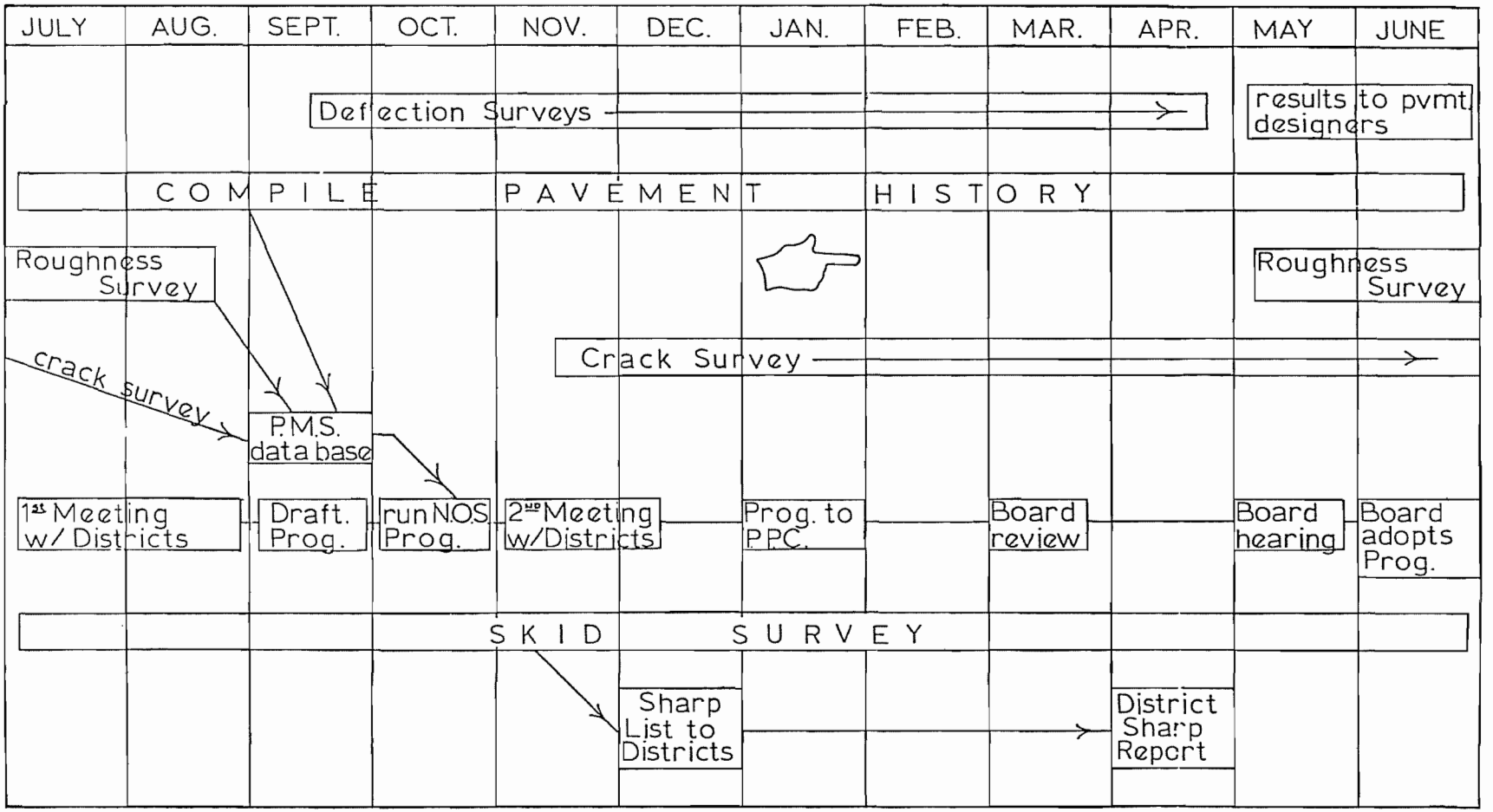
1. Complete the annual pavement condition inventory on schedule.

2. Analyze the data collected on a network basis for network optimization to determine the appropriate maintenance strategy for the various highway segments. The pavement condition data, traffic data and climate data are used to predict pavement distress in future years. An optimization program uses prediction models in matrix form, as well as, other input constraints to determine the least cost set of pavement improvements (seal coats, overlays etc.) to maintain the highway network.

A five year preservation program is developed from the data and interaction with Districts and ADOT Management. For the first three years, specific projects are identified and funded. In the last two years a budgeted amount of money is estimated to fund projected preservation projects.

The yearly work program for the major duties of Pavement Management and Evaluation is shown in Figure 300.01-1.

PAVEMENT PERFORMANCE WORK SCHEDULE



P.M.S. – Pavement Management System
N.O.S. – Network Optimization System
P.P.C. – Priority Planning Committee
SHARP – Skid Highway Accident Reduction Program

FIGURE 300.01-1

3. Provide deflection data to the pavement designers for the purpose of determining the structural adequacy of each preservation project.

4. Maintain, as resources allow, a computer file of pavement condition, history, traffic, materials tests and all other pertinent data for the pavement management and design process.

5. Complete a condition inventory of airports within available time constraints.

6. Respond to requests from various government agencies such as the Attorney General, Department of Public Safety, Federal Highway Administration, Transportation Research Board, AASHTO, Universities, Foreign Countries and others.

7. On a three year cycle develop in cooperation with management a pavement preservation policy, which documents pavement management goals on a highway network basis.

301.00 PAVEMENT EVALUATION

Pavement Evaluation encompasses those functions relating to the field testing of the highway system to obtain all or part of the data needed for Pavement Management and pavement structural design.

301.01 DEFLECTION MEASUREMENT

Deflection measurements on pavements are made by ADOT currently with two devices, the Dynaflect and the Falling Weight Deflectometer (FWD). These are electro-mechanical systems for measuring deflections of pavements from an applied load.

The following is a brief description of both of these devices:

A. THE FALLING WEIGHT DEFLECTOMETER

The Falling Weight Deflectometer (FWD) is a testing apparatus that transmits to the pavement an 18,000 pound single axle load by a falling weight. The FWD applies a specified pavement loading, and measures the actual applied load and deflections. The FWD provides test results that can be used to determine the modulus of the subgrade and the pavement layers.

The FWD trailer includes the falling weight load plate, a force transducer, and seven deflection transducers. A computer processes the test data and produces a printout. By using a computer program, the modulus (E-value) can be calculated from the test data.

B. THE DYNAFLECT

The Dynaflect is a testing apparatus which uses a 1000 pound cyclic load and records deflections to determine the response of a pavement.

The Dynaflect trailer includes an eight cycle per second 1000 lb. force generator, deflection sensors, and a data acquisition system.

To test the deflections due to the cyclic loading, the first sensor is lowered to a point midway between the two force wheels. The remaining four geophones are placed on one foot center-to-center spacing from the 1st sensor. The load is applied and the deflections from the sensors are recorded.

C. DATA ANALYSIS

The data obtained from the FWD or the Dynaflect may be plotted to form a "deflection basin", which may be useful in evaluating structural adequacy of the roadway at the test site. Also, index values are utilized to numerically define the shape of the deflection basin. Those index values are:

1. Surface Curvature Index (S.C.I.), defined as the numerical difference between measured deflections of the first sensor and the second sensor.

2. Base Curvature Index (B.C.I.), defined as the numerical difference between measured deflections of the last sensor and the next to the last sensor.

3. The Maximum Deflection (M.D.), is defined as the value of the measured deflection of the first sensor.

4. The Spreadability Index (S.I.) is defined as the sum of all the sensor readings divided by the number of sensors times the first sensor reading and that result is then multiplied by 100.

$$SI = \frac{(d1 + d2 + d3 + d4 + \ldots dN)}{N \times d1} \times 100$$

By observing the S.C.I., B.C.I., M.D., and the S.I. a qualitative analysis is available for the structural adequacy of the roadway at the test site.

301.02 SURFACE ROUGHNESS MEASUREMENT

One of the major criteria of an adequate roadway is the comfortable and safe ride it provides the travelling public. It is important that there be a method to objectively determine if the road is sufficiently smooth.

Effective February 1, 1992, ADOT has converted all of the existing Mays-meter historical data to true Mays-meter data in accordance with the standard methods in NCHRP Report #228, "Calibration of Response-Type Road Roughness Measuring Systems". All references to and use of Mays-meter data following February 1, 1992 are based on the new, true Mays-meter values. All references in this manual reflect those changes through the issuance of Change Letter No. 2, March 1992.

The equipment used by ADOT to measure road roughness is the Mays Ride Meter. It measures the roughness of the pavement surface by recording the movement between the rear axle and the body of the car.

The Mays ride meter is mounted in a full-sized car equipped with coil springs, firm shock absorbers, and front and rear anti-roll bars.

The roadway roughness is measured in one tenth of an inch increments (counts) by a transmitter that is rigidly mounted in the trunk directly above the axle. As the rear axle moves up and down relative to the car body the transmitter rotates and provides the counts.

The recorder in the front seat receives the roughness counts from the transmitter and prints out the accumulated total and the distance traveled during the test.

The counts from the transmitter are converted to inches per mile by dividing the total roughness counts by the distance over which they were measured (usually 1 mile). These results are adjusted by the calibration for the specific vehicle. The final results are normally used for indicating roughness although they may be converted to a present serviceability rating (PSR) by the equation:

$$PSR = \left[4.6836 * \left[0.9970^{(((\text{Mays-meter value})-4.255)/0.54)} \right] \right] + 0.3488$$

301.03 VISUAL OBSERVATIONS AND PHYSICAL MEASUREMENTS

Although the surface roughness is the predominant factor in determining the serviceability level of a pavement, there are 3 other factors that have a bearing on serviceability. Cracking, patching, and rutting are usually measured visually over a specified area. A surface condition survey of the entire state highway system is performed each year. The amount of cracking, patching, rutting, and flushing at every milepost is recorded to determine the present condition of the roadway.

301.04 MEASUREMENT OF FRICTIONAL CHARACTERISTICS

One important characteristic of a pavement is surface friction. Test Information is used to determine the adequacy of surface friction on roadways to meet the traffic demands. Collection of friction data is done as manpower is available after condition survey, and roughness surveys are accommodated. Every attempt is made to assure that testing is done on any problem areas that are identified. Whenever possible, proposed rehabilitation projects are also tested.

The device used by ADOT to determine surface friction is the Mu-meter, a continous recording friction measuring trailer. It measures the side-force friction generated between the test surface and the two pneumatic tires which are each set at a fixed toe-out angle of 7-1/2 degrees. This frictional force is sensed by a transducer located near the apex of the trailer's frame. During a test, water is sprayed under the test tires to simulate wet pavement conditions. For special studies, dry tests can also be performed. Generally tests are made for 500 feet and inventory tests normally begin at the milepost.

301.05 FLEXIBLE PAVEMENTS

A. Cracking

The amount of cracking of the pavement is recorded as a percentage of a 1000 square foot area at each milepost. A procedure was originally developed from an analysis of pictures of road surfaces with different levels of cracking subdivided into a 1000-compartment grid.

To estimate cracking on the roadway, previously analyzed pictures of known percent cracking are compared to the road surface and the percent cracking of the area is determined.

B. Patching

The amount of patching is reported as a percentage of a 1000 square foot area at the milepost. Patching is defined as any surface treatment placed by maintenance forces. Patching is usually found in small isolated spots but can occasionally be seen over the entire width of the roadway for a hundred feet or more.

C. Flushing

Flushing results from an excess of asphalt on the surface of the pavement.

Flushing is recorded as a severity rating from 1 - severe and bleeding, to 5 - no flushing.

D. Rut Depth

Rut depth is defined as the mean depth of a rut in the wheelpaths of the pavement where the rut is the depression under the center of a four foot straight edge.

301.06 RIGID PAVEMENTS

A. Patching

Patching is reported the same way as for flexible pavements.

B. Faulting

Faulting at the joints occurring in the 1000 square foot area, is measured and reported to the nearest 0.01 inch.

301.07 DATA INTERPRETATION

Table 301.07-1 describes qualitatively the meaning of various pavement management data.

TABLE 301.07-1

GUIDELINES USED FOR CATEGORIZING PAVEMENT

MU-METER NUMBER:	
HIGH	43-99
MEDIUM	35-42
LOW	Less than 35
ROUGHNESS:	
SATISFACTORY	**0-93 in/mile**
TOLERABLE	**94-142 in/mile**
OBJECTIONABLE	**143 + in/mile**
PERCENT CRACKING:	
LOW	Less than 10
MEDIUM	10-30
HIGH	Greater than 30
ANNUAL MAINTENANCE COST (PER LANE MILE):	
LOW	0-333
MEDIUM	334-666
HIGH	Greater than 666
TRAFFIC - AVERAGE DAILY TRAFFIC (ADT)	
VERY LOW	$\leq$500
LOW	501-2000
MEDIUM	2001-10,000
HIGH	Greater than 10,000
TRAFFIC - 10 YEAR CUMULATIVE 18 KIP SINGLE AXLE EQUIVALENT LOADS (ESAL's):	
LOW	0-50,000
MEDIUM	51,000- 375,000
HIGH	376,000-1,250,000
VERY HIGH	Greater than 1,250,000
SEASONAL VARIATION FACTOR:	
LOW	Desert 0-1.7
MEDIUM	Transition 1.8-2.7
HIGH	Mountains Greater than 2.7

TABLE 301.07-1 (Cont'd.)

GUIDELINES USED FOR CATEGORIZING PAVEMENT

DEFLECTION: FIRST GEOPHONE - MILS (1 mil = 0.001 inch)

	Dynaflect	FWD
LOW	Less than 1.0	Less then 25
MEDIUM	1.0 - 1.5	25 - 40
HIGH	1.5+	40+

SPREADABILITY INDEX:

STRONG STRUCTURE	46 or More
MEDIUM	35 - 45
WEAK	Less than 35

RUT DEPTH

LOW	.0 - .25 IN.
MEDIUM	.26 - .50 IN.
HIGH	.51+ IN.